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Undercut bilayer resist systems of the type depicted in Figs. 1a-1e can be fabricated using e-beam lithography rather than photolithography. The present sensor trackwidths of 0.3 micron are already beginning to push the resolution limits of I-line photolithography. Fundamental constraints such as the diffraction limit of light make photolithographically patterning sub-0.2 micron TW sensors with I-line radiation practically impossible. Electron beam lithography has no such resolution limits, which make it an attractive (but by no means the only) choice for patterning ultra-narrow trackwidth MR sensors. Figs. 2a-2b are schematic diagrams illustrating the top and side views of a bilayer resist pedestal using an e-beam resist chemistry technique. An e-beam sensitive image resist layer **206** is deposited on a resist layer **204**, which cannot be seen in Fig. 2a. The open regions **202** on the image resist layer **206** are formed by exposing those regions to an electron beam and then dissolving the exposed resist in a suitable developer. The undercut is then formed by using an appropriate developer to dissolve the bottom resist layer, where the undercut distance is determined by the develop time.

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## BRIEF DESCRIPTION OF THE FIGURES

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Figs. **1a-e** are schematic diagrams illustrating the steps of a process of fabricating MR sensors using a bilayer resist pedestal technique of the prior art;

5 Figs. **2a-b** are schematic diagrams showing top and side views of a bilayer resist pedestal structure of the prior art;

Figs. **3a-b** are schematic diagram showing top and side views of a bilayer fully undercut resist structure according to a preferred embodiment of the present invention;

10 Figs. **4a-d** are schematic diagrams illustrating the steps of a process of making the bilayer fully undercut resist structure shown in Figs. 3a-b;

15 Figs. **5a-e** are schematic diagrams illustrating the steps of a process of fabricating a GMR sensor using the fully undercut resist bridge illustrated in Figs. 4a-d;

Figs. **6a-f** are schematic diagrams illustrating the steps of a process of fabricating a MTJ sensor using the fully undercut resist structure illustrated in Figs. 4a-d;

20 Fig. **7** is a TEM cross-section of a GMR sensor fabricated using the process described in Figs. 5a-e;

Fig. **8** is a cross-sectional schematic diagram of a MR read head including the MR sensor illustrated in Figs. 5a-e and 6a-e; and

25 Fig. **9** is a schematic diagram illustrating a disk drive including the MR read head of Fig. 8.

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The fully undercut resist bridge formed by the process described in Figs. 4a-4d may also be used for fabricating MTJ sensors. Figs. 6a-6f illustrate a process for fabricating a MTJ sensor using a fully undercut resist bridge. As shown in Fig. 6a, a fully undercut resist bridge **600** is positioned on top of a MTJ layer structure **602**. Ion beam milling on the MTJ layer structure **602** defines an MTJ sensor **601** with trackwidth equal to the width of the bridge **600** (TW) as shown in Fig. 6b. Insulating layers **604** are deposited adjacent to the MTJ sensor **601** before hard bias layers **606** are deposited to form the longitudinal bias for MTJ sensor **601**, as shown in Fig. 6d. Insulating layers **604** provide electrical insulation between the hard bias layers **606** and the MTJ sensor **601**. Other insulating layers **608** are deposited on the hard bias layers **606** to electrically insulate the hard bias layers from leads that are deposited in a separate process, which is not shown in Fig. 6. Finally, the resist bridge **600** is removed via liftoff processing from the MTJ sensor **601** as shown in Fig. 6f. As shown in Figs. 6c-6e, a quantity of hard bias material **606'** and insulating material **604'** and **608'** is also deposited onto the top and sidewalls of resist bridge **600**. However, this material is removed along with the resist layer **600** in a liftoff process described in Fig. 6f.

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FOOTNOTES